PLANCK Sorption Cooler Initial Compressor Element Performance Validation Results

Christopher G. Paine, Robert C. Bowman Jr, Pradeep Bhandari, Lawrence A. Wade
Jet Propulsion Laboratory, California Institute of Technology

Planck is an ESA-led mission to map the cosmic microwave background using bolometric and hetrodyne instruments; both instruments require cooling, one to ~20K, the other to 0.1K. JPL is developing a sorption-based hydrogen cooler to provide 18-20 K to the two instruments. The requirement of 18 months of cooler operation is challenging the SOA in hydriding alloys, and the system mass and power limitations require tradeoffs in thermal design. To demonstrate achievement of an acceptable design, three compressor elements of a flight-like configuration have been built and are undergoing characterization and life tests. The compressor elements utilize a $LaNi_{4.78}Sn_{0.02}$ alloy for reversible hydrogen storage, resistive heaters, and an aluminum foam matrix for thermal uniformity, all contained within a high-pressure vessel. A gas-gap switch provides adjustable thermal isolation. Initial results indicate that hydriding alloy bulk and surface contamination levels are insignificant, and that reversible storage capability is near theoretical limits. We report on initial degradation rates for the hydriding material, and on static and dynamic thermal characteristics of the compressor elements.

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